November 12, 2009

Certified Mail No. 7006 2150 0005 1859 7017
Return Receipt Requested

Richard Goodyear, P.E.
Permit Programs Manager
Air Quality Bureau
New Mexico Environment Department
1301 Siler Road, Building B
Santa Fe, NM 87507

Re: Permit No. 325-M-9, Rev.22 - Technical Permit Revision

Dear Mr. Goodyear,

Pursuant to Condition 1.G of Air Quality Permit No 325-M-9, Rev. 22 (Permit), Intel submits the following proposed technical permit revision to change the emission factors (EFs) for hazardous air pollutants (HAP) and volatile organic compounds (VOCs) in Tables 3 and Z. Tables 3 and Z contain the HAP and VOC EFs used to calculate Intel's twelve-month rolling total HAP and VOC emissions. The proposed revision reflects inclusion of VOC and HAP emission factors for several chemicals. Enclosure 1 provides the detail for changes to the emission factors.

Pursuant to 20.2.72.219.B.6 NMAC, Intel will provide notice by certified mail to all municipalities, Indian tribes, and counties within a ten-mile radius of the site and publish as required. Copies will be sent separately. If you have any questions or need additional information, please contact Sarah Chavez at (505)794-4917.

Sincerely,

Frank Gallegos
NM Site Environmental, Health & Safety Manager

Enclosure 1: HAPs and VOC Emission Factor Explanation with Updated Emission Factors

CERTIFICATION

I, Frank E. Gallegos, Intel Site EHS Manager, hereby certify that the information and data submitted in this application are true and as accurate as possible, to the best of my knowledge and professional expertise and experience.

Frank E. Gallegos

STATE OF NEW MEXICO)
)ss.
COUNTY OF SANDOVAL)

Subscribed and sworn before me on this 12 day of November, 2009 by Frank E. Gallegos.

Sondra K Britt

[My commission expires: MAY 22 2012

Enclosure 1
HAPs and VOC Emission Factor Explanation

Emission Factor Development

The following approach to emission factor development at the site is the same approach used in the October 1999 minor source permit application.

Semiconductor manufacturing is essentially a series of batch operations. Typically, a process step will be performed on a batch of wafers, the processing chamber will be emptied, and the next batch will be inserted to start the process over. A batch size at Intel can range from 1 - 25 wafers. For the selected process steps, emissions were tested over the course of several batches. Each time a batch is run, the process recipe is followed precisely, so the chemical inputs are known. During the course of the testing, emissions were measured directly from the individual tool each time a batch of wafers was run (see Attachment 1 for analytical procedure). This was typically repeated 5 - 10 times. The airflow in the tool exhaust was also measured prior to the start of the testing. The total mass of emissions (lbs.) was then calculated for the process step by determining the average concentration in the exhaust of the pollutant of concern, and multiplying by the air flow rate. Due to the very consistent nature of the process recipes, a very high degree of repeatability was observed among the multiple tests of an individual step.

The measured emissions were then converted into a simple emission factor as follows:

> Emission factor = (measured output of chemical of concern)/(process recipe input of producing chemical).

For example, one process step uses 2.5×10^{-3} lbs. of chlorine gas for every wafer produced. The emissions testing on this step produced an average result of 8.3×10^{-5} lbs. hydrochloric acid (HCl) per wafer, and 1.8×10^{-3} lbs. chlorine (Cl2) per wafer. The emissions factors developed from these tests for this process step were:

> EF Cl2 to HCl = $(8.3 \times 10^{-5})/2.5 \times 10^{-3}) = .03$
> EF Cl2 to Cl2 = $(1.8 \times 10^{-3})/2.5 \times 10^{-3}) = .72$

In other words, on this process step every 100 lbs. of chlorine used will generate 3 lbs. of HCl emissions and 72 lbs. of Cl2 emissions.

The following are other example calculations for emission factors:

Example 1.

Ethyl lactate is used on lithography tracks. The amount of ethyl lactate used per wafer is rigorously defined for a given process and does not vary from wafer to wafer. Intel performed emissions testing on various manufacturing steps of the lithography track tools. This was performed with real time FTIR measurements during actual wafer manufacturing. On a given process step, anywhere from 5 to 25 wafers would be tested, over a total time of 5 – 60 minutes.

Six different lithography track steps were tested. The results of these tests and the way the data was turned into an overall ethyl lactate (EL) emission factor are shown below.

Enclosure 1: HAPs and VOC Emission Factor Explanation

	EL Use lbs./wafer	EL Emissions lbs./wafer
Step 1	.00091	0.00023
Step 2	.00728	0.00160
Step 3	.00091	0.00018
Step 4	.00091	0.00018
Step 5	.00182	0.00036
Total	*.01183*	*0.00255*

Overall EF = total emissions/total use = .00255/.01183 = 0.22

All ethyl lactate emissions from this process are vented to the control devices. An efficiency of 97% was assumed, based on current tests results of those devices(see Attachment 3 for details).

Emission Factor x (1 - % removal efficiency) = post abated emission factor

0.22 x (1-0.97) = 0.0066 lbs EL emissions/lb EL use

Example 2.

Methanol is used in two different locations in the fab – metal etch and lithography. In the metal etch process, emissions were found to be zero because the autoignition temperature of methanol is listed as 470°F, and the operating temperature of the metal etch chamber is higher than this. The methanol used in these operations come in two different types of containers with two different Intel part numbers. This makes it easy to determine which portion of the methanol is used in metal etch vs. lithography.

In lithography, methanol is used on only one manufacturing step. This step was tested four times, with each test consisting of 5 wafers through. The results of the four tests were as follows

Run #	Methanol Use (lb/wafer)	Methanol Emission (lb/wafer)
1	0.0162	5.1 x 10-3
2	0.0162	3.9 x 10-3
3	0.0162	6.2 x 10-3
4	0.0162	4.6 x 10-3

Average Emission Factor = .30

All methanol emissions from this process are vented to the control devices. An efficiency of 96% was assumed, based on current tests results (see Attachment 3 for details).

Emission Factor x (1 - % removal efficiency) = post abated emission factor

0.3 x (1-0.96) = 0.012 lbs Methanol emissions/lb Methanol use

Example 3.

Since most HAPs chemicals are used on more than one process step, overall process emission factors were developed for all HAP producing chemicals used in the process. The overall emission factor defines the total amount of a given chemical on a given process which will be converted to a HAP. For example, if a given process step uses sulfur hexafluoride (SF_6) in three places, the overall emission factor will be determined by adding the results of all three of those process steps as shown below

Process Step	**Chemical pathway**	**Chemical Use, lbs./wafer**	**Emissions, lbs./wafer**
Etch 1	SF_6 to HF	2×10^{-3}	2×10^{-5}
Etch 2	SF_6 to HF	5×10^{-3}	1×10^{-5}
Etch 3	SF_6 to HF	3.5×10^{-3}	1.05×10^{-5}
Total		*1.05×10^{-2}*	*4.05×10^{-5}*

Overall EF = (total emissions/total use) = $4.05 \times 10^{-5} / 1.05 \times 10^{-2} = 0.004$

All hydrofluoric acid (HF) emissions from this process are vented to the control devices. An efficiency of 70% was assumed, based on current tests results of those devices (see Attachment 2 for details).

Emission Factor x (1 - % removal efficiency) = post abated emission factor

0.004 x (1-0.70) = 0.0012 lbs HF emissions/lb SF_6 use

Removal Efficiencies

The efficiency of the abatement system is taken into account to calculate the overall emission factor after abatement using the following equation:

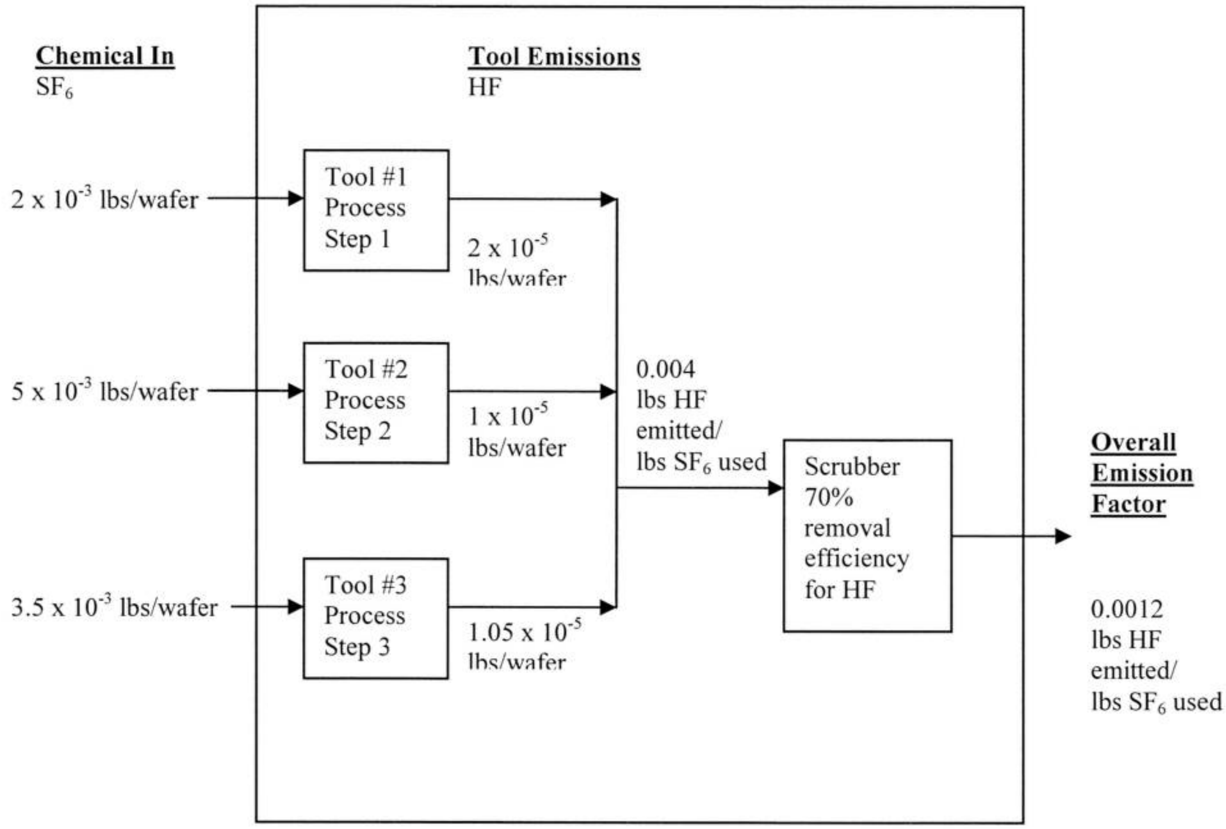
EF (after abatement) = EF (prior to abatement) x (100% - % abatement efficiency)

The abatement efficiencies listed below were used to derive the emission factors after abatement and were based on stack testing. The abatement efficiencies were not changed for this submittal.

Methanol = 96%
Hydrofluoric Acid = 70%
Hydrochloric Acid = 69%
Chlorine = 53%
VOCs routed to thermal oxidizer (other than Methanol) = 97%
All other chemicals were assumed to have 0% abatement efficiency.

The following diagram depicts how the emission factor is calculated for Example 3 above:

Enclosure 1: HAPs and VOC Emission Factor Explanation



Enclosure 1: HAPs and VOC Emission Factor Explanation

Table 3 (page 1 of 1)
Emission Factors for HAPs[1]

Pollutant	**Chemical or Precursor**	**Emission Factor**			
		G	H	I	J
HF					
SF6 to HF	Sulfur Hexafluoride (SF6)	0.0047	-	0.0009	-
CF4 to HF	Carbon Tetrafluoride (CF4)	0.0025	-	0.0037	-
CHF3 to HF	Trifluoromethane (CHF3)	0.0337	-	0.0114	-
NF3 to HF	Nitrogen Trifluoride (NF3)	0.0046	0.0047	0.0057	0.0046
WF6 to HF	Tungsten Hexafluoride (WF6)	0.0341	-	0.0341	-
C4F8 to HF	Octafluorocyclobutane (C4F8)	0.0255	-	0.0294	-
CH2F2 to HF	Difluoromethane (CH2F2)	0.0362	-	0.0248	-
C5F8 to HF	Octafluorocyclopentene (C5F8)	0.0343	-	0.0334	-
BF3 to HF	Boron Trifluoride (BF3)	0.0600	-	0.0600	-
HF to HF	Hydrogen Fluoride (HF)	-	0.1364	-	-
C4F6 to HF	Hexafluoro-1,3-butadiene (C4F6)	0.0508	-	0.0100	-
HCl					
Cl2 to HCl	Chlorine (Cl2)	0.0835	-	0.0500	-
DCE to HCl	Trans 1,2-Dichloroethene (DCE)	0.1004	-	0.1004	-
DCS to HCl	Dichlorosilane (DCS)	0.0002	-	0.0002	-
HCl	Hydrogen Chloride (HCl)	0.0017	-	0.0932	-
HCl	Hydrogen Chloride (HCl) VMB	0.0961	-	0.0961	-
HCl	Hydrogen Chloride (HCl) RFC	0.3100	-	0.3100	-
11AVD to HCl	11AVD	0.1021	-	0.1021	
Cascade to HCl	Cascade	0.1021	-	0.1021	
ACME to HCl	ACME	0.0024	-	0.1550	
Cl2					
Cl2	Chlorine (Cl2)	0.2921	-	0.4372	-
DCE to Cl2	Trans 1,2-Dichloroethene (DCE)	0.0940	-	0.0940	-
DCS to Cl2	Dichlorosilane (DCS)	0.0000	0.0000	0.0000	0.0000
Others					
Titanium Tetrachloride	Titanium Tetrachloride	0.7100	0.7100	0.7100	0.7100
Ethylene Glycol	Ethylene Glycol	0.000005	0.000005	0.000005	0.000005
1,4 Dioxane	1,4 Dioxane	0.0000	0.0000	0.0000	0.0000
Cl2 to CCl4	Chlorine (Cl2)	0.0058	-	0.00001	-
Methanol	Methanol (abated)	0.0181	-	0.0181	-
Methanol (gensolve)	Methanol (abated)	-	0.0004	-	0.000004
AsH3	Arsine (AsH3)	0.0050	-	0.0050	-
PH3	Phosphine (PH3)	0.0050	-	0.0893	-
Diethylene Glycol Monomethyl Ether	Diethylene Glycol Monomethyl Ether	0.0000	-	0.0000	
Bromoform*	Sodium Bromide – CUB	0.0605			
Bromoform*	Sodium Bromide – NEC	0.0096			
LCP Oxide Etch to NH3	LCP Oxide Etch	0.0008		0.0008	
LCP Oxide Etch to NOx	LCP Oxide Etch	0.0005		0.0005	
Any Other HAP Listed In Appendix X[2]		1			

Notes: 1 Emission factors take into account control efficiencies, where applicable. Chemicals having emission factors equal to zero (0.0) are either completely consumed in the process or are solid sources with negligible vapor pressures. Intel may revise the emission factors following Condition 1.G. EFs for processes no longer in use have been removed from this table.

Enclosure 1: HAPs and VOC Emission Factor Explanation

2 This category does not include those HAPs chemicals for which Intel uses the sink evaporation equation specified in Condition 5.D.iv to calculate emissions.

*Site EF, not associated with a single process

"- "chemical not used on this technology

Enclosure 1: HAPs and VOC Emission Factor Explanation

Table Z (page 1 of 1)

Emission Factors for VOCs

Pollutant	Emission Factors			
	G	H	I	J
Bis(tertbutylamino)silane	0.000005	0.000005	0.000005	0.000005
5-Chloro-2-methly-4-isothiazolin 3-one	0.0000	-	0.0000	-
Carbon Monoxide*	1.0000	1.0000	0.2139	-
1,2-Cyclohexylenedinitrilotetraacetic acid	0.0000	-	0.0000	-
Cyclohexane, 1,1'-[(diazomethylene bis(sulfonyl)]bis-	0.0000	0.0000	0.0000	0.0000
Cyclohexane-1,4-dimethanolmonovinylether	0.0000	0.0000	0.0000	0.0000
Cyclohexanone	0.0051	-	0.0029	-
Diethyl Ketone	0.0026	-	0.0026	-
Diethylene Glycol Monomethyl Ether	0.0000		0.0000	
Dimethyldimethoxysilane (DMDMOS)	0.0153	-	0.0933	
1,4 Dioxane	0.0000	0.0000	0.0000	0.0000
Ethanol	0.0150	-	0.0156	-
Ethanol (Polyimide)	0.0133	-	0.0133	-
2-Ethyl 1-Hexanol	0.000005	0.000005	0.000005	0.000005
Ethyl Lactate	0.0047	0.0135	0.0055	0.0135
Ethylene Glycol	0.000005	0.000005	0.000005	0.000005
Gamma-Butyrolactone	0.0071	-	0.0058	
1-Heptanethiol	0.000005	0.000005	0.000005	0.000005
Hexafluoro-1,3-butadiene (C4F6)	0.1226	-	0.3263	
Hexamethyldisilazane (HMDS)	0.0163	-	0.0171	-
Isoamyl Ether	-	-	0.0058	-
Isopropyl Alcohol (abated)	0.0062	0.0125	0.0057	0.0161
Isopropyl Alcohol (bottled)	0.9020	-	0.9020	-
Isopropyl Alcohol (SLAM)	0.0153	-	0.0167	-
Malonic Acid	0.0000	-	0.0000	-
Methanol (gensolve)	-	0.0004	-	0.000004
Methyl Isobutyl Carbinol	-	-	0.0058	-
2-Methly-4-isothiazolin 3-one	0.0000	-	0.0000	-
Methyl n-amyl ketone (2-Heptanone)	-	0.0135		0.0135
1-Methyl-2-pyrrolidinone (NMP)	0.0005	-	0.0005	
1-Methyl-2-pyrrolidinone - (470)	-	0.0009		0.000004
n-Butanol	0.0049	-	0.0049	
Octafluorocyclopentene (C5F8)	0.1472	-	0.1588	
PDMAT	0.0092	-	0.0092	-
Propylene Glycol Monomethyl Ether (PGME)	0.0058	0.0105	0.0167	0.0099
Propylene Glycol Monomethyl Ether Acetate (PGMEA)	0.0059	-	0.3513	
Propene (C3H6)	-	-	0.1883	-
Tetrakis(dimethylamino)titanium (TDMAT) to Diethyl Amine	0.0300	-	0.0300	-
Tetramethylsilane	0.0100	-	0.0100	
Trans 1,2-Dichloroethene (DCE)	0.0000	-	0.0000	-
Triflic acid	0.0000	0.0000	0.0000	0.0000
Any Other VOC chemicals[2]	1			

Notes:

[1] Emission factors take into account control efficiencies, where applicable. Chemicals having emission factors equal to zero (0.0) are either completely consumed in the process or are solid sources with negligible vapor pressures. Intel may revise the emission factors following Condition 1.G. EFs for processes no longer in use have been removed from this table.

[2] This category does not include those VOC chemicals for which Intel will use the sink evaporation equation specified in Condition 4.D.iv.a to calculate emissions.
* Carbon Monoxide is not a VOC but will be reported with site CO emissions
"- "chemical not used on this technology

Emission Factor Weighting

At Intel, multiple manufacturing processes are being run at any given time. Each manufacturing process may use chemicals in different quantities and have a different emission factor. In order to more accurately calculate emissions, emission factors for each individual manufacturing process are being proposed for inclusion in the permit and are included in Tables 3 and Z above. To calculate emissions each quarter, the actual production level will be used to allocate the chemical use for the site to the various processes. This approach to weighting is the same approach that was submitted and explained in the August 2002 emission factor update. The weighted average is calculated as follows:

$$WA_A\ (\%) = \frac{CU_A \times WS_A}{(CU_A \times WS_A + CU_B \times WS_B + CU_C \times WS_C + \ldots)}$$

where:

WA_A = Weighted average for Process A (%)
CU_A = Chemical Usage for Process A (pounds/wafer processed)
WS_A = Actual production level for Process A (wafers processed/quarter)
CU_B = Chemical Usage for Process B (pounds/wafer processed)
WS_B = Actual production level for Process B (wafers processed/quarter)

The weighted average (%) for process A is the chemical usage for process A multiplied by the actual production level for process A divided by the sum of the chemical used for individual processes multiplied by the actual production level for the individual processes.

Emissions for a particular chemical would then be calculated as follows:

$$\text{Site Emissions}_1 = WA_A \times EF_A \times ACU_1 + WA_B \times EF_B \times ACU_1 + WA_C \times EF_C \times ACU_1 + \ldots$$

where:

Site Emissions_1 = Emissions for Chemical 1 (i.e. chlorine, methanol)
WA_A = Weighted average for Process A (%)
EF_A = Emission Factor for Process A
ACU_1= Actual chemical use for Chemical 1 (i.e. chlorine, methanol)
WA_B = Weighted average for Process B (%)
EF_B = Emission Factor for Process B

The site emissions for chemical 1 (i.e. chlorine) is the total of the weighted average (%) for an individual process multiplied by the emission factor for the individual process multiplied by the actual chemical use for chemical 1.

Enclosure 1: HAPs and VOC Emission Factor Explanation

The following table and equations provide an example calculation for site emissions of HF from SF_6:

	Process A	Process B	Process C	Process D	Site
Production (wafers processed/quarter)	5000	750	1000	2000	
Chemical Usage for Process (lbs SF_6 /wafer processed)	2.01E-02	1.37E-02	1.05E-02	5.24E-03	
Weighted Average for Process (%)	76%	8%	8%	8%	
Emission Factor for Process	0.0074	0.024	0.0079	0.0051	
Actual Chemical Usage SF_6 (lbs)					140
Emissions HF (lbs)					6.2

The following calculation shows the how the weighted average for Process A is determined:

$$WA_A = \frac{5000x2.01E-02}{5000x2.01E-02+750x1.37E-02+1000x1.05E-02+2000x5.24E-03} = 76\%$$

The following calculation shows how the site emissions for HF from SF_6 would be determined:

$$SiteEmissionsHF = 0.76x0.0074x140 + 0.08x0.024x140 + 0.08x0.0079x140 + 0.08x0.0051x140 = 6.2lbsHF$$

Attachment 1

Analytical Method used for Tool Testing

The following is an excerpt outlining the analytical method used for tool testing. This document is updated frequently and is subject to change.

http://www.sematech.org/docubase/document/4197axfr.pdf